The
Benjamin Smith Lyman
Collection

Given as a Memorial
to
Forbes Library
Northampton, Mass.
by
His Heirs

1813

A

(3) unnumbered pages out of sequence (?)

B
C

D
E

F
G

II
J

K
L

M
N

Q
R

S
T

X
Y
Z

Land Measuring

for Boards, Mines, Roads, Canals, Waters, Trees, Lockbeing, and the [illegible]

The business of Land Measuring seems to have been carried on first by the Egyptians at least thirteen hundred years before Christ. It embraces not only I, measuring, so as to find out the size, shape and place of larger or smaller pieces of land; but II, the setting down or recording (p. 1), and the showing forth or displaying the facts to others, so that the measurement may be made again on the ground if need be (p.). The word land, [illegible] in law means not merely a part of the earth's surface, but everything joined to it, as trees, buildings or bodies of water, and any part of the earth below the surface, as mines, caves or rock-veins. All three parts of the work should be faithfully, rightly and handsomely done; but in particular the measuring should be honest, the record truthful and the display useful.

I. Measuring.

In measuring gross mistakes of counting are often made, and it is therefore well to check a measurement by making it again; not perhaps so nicely, but in such a way as to make sure against such a mistake of counting.

Even with the greatest care a measurement made by man is never sure to be thoroughly exact; but it is plain that if it be made over and over again with a [illegible]

[illegible] to the means [illegible] of the [illegible] will be likely to be sometimes more than the truth, sometimes less, so that the mean of all the readings will be likely to be more exact than any one. This likelihood of being thoroughly exact is called the precision (sharpness) of the measurement; and the precision of the mean of several equally precise readings is known (by the Method of Least Squares in the Theory of Probabilities) to increase as the square root of the number of readings. For example: the mean of four equally precise measurements of one thing will be twice as precise as any one of them; of [illegible] as precise as one; of [illegible] four times [illegible] as one, or twice as precise as four; of [illegible] four times as precise as one. It is [illegible] with [illegible] bas increase [illegible]; and where [illegible] great [illegible] in measurement [illegible] it is [illegible], a measurement is [illegible] made more than [illegible] times.

A measurement may often be checked very well by other measurements joined to it in [illegible] way [illegible] when the length of one line answers to a certain length of another line.

The shape and size of a piece of land can be made out from the mere place of a large enough number of its points. The measuring therefore, embraces 1° the way of fixing the points, and 2° suitably choosing points to be fixed.

1° Fixing Points.

The place of a point is fixed by its height above or below a given level (in large land measurements commonly the sea level) and by the place of the nearest point on that level, say by the one where would pass a freely swinging plumb line from the point to be fixed. The place of this point on the level is fixed by its distance, or direction, or both, from lines or other points on the same level. A level surface on the earth, such as the sea level, is well known not to be flat, as once believed, but the surface of a round, very slightly flattened ball.

The measurements, [illegible] are either, a, level measurements or b, height measurements (p.).

a. Level Measurements.

To fix the place of point [illegible] brought by a plumb line as it were upon a common level needs the measurement on the level, a, of distances, and, b, of angles (p.); and, c, combining both in such a way as to fix the points (p.).

It was formerly customary to make measurements along the slope of the ground instead of [illegible] pains to do it on a level; but it is clear that they [illegible] in such a [illegible] need changing whenever the slope should by nature or by man be changed, and that they could [illegible] be laid down in small upon paper or any flat [illegible] without often overlapping and leading to

many mistakes. The plan of measuring as to bring all the [illegible] to a common level is called [illegible] the method of [illegible] and was first taken up about [illegible]. Measurements [illegible] made on the slope of the ground, but then in working up the [illegible] the level measurements are [illegible] out from the slope measurements and their slope angle.

a, Distance. The distance between any two points must be measured along the shortest level line from one to the other. On a flat surface this line would be straight, and may be taken as for short distances on the earth; on a perfect ball it would be part of a great circle, in one flat plane with the centre of the ball; but as the earth is a flattened ball, such a line [illegible] called the geodetic line would have a double [illegible] [illegible] wholly [illegible] the equator or [illegible] meridian. To get the distance [illegible] [illegible] line [illegible], and [illegible] line [illegible].

a, Line Facing. How to [illegible] a [illegible] geodetic line [illegible] where a signal cannot be seen from one end of the [illegible] it to the other comes under the head of working up the [illegible]; but a shorter or less exact line [illegible] where a signal can be seen from one end of it to the other may be taken as [illegible] or at least as a great circle upon a ball, and may be [illegible] on the ground without ciphering beforehand and [illegible] out any more instruments. This is clearly done [illegible] if both ends of the line can be seen from [illegible]

a

03

Aiken, 18 Nov. 1870.

[illegible]
Aiken.

[illegible] Yesterday [illegible] of
[illegible] I [illegible] at yesterday's [illegible]
[illegible] [illegible] kind. Mr. [illegible]
[illegible] [illegible] you I beg to urge my appeal
[illegible] and [illegible] Ku Klux [illegible] having [illegible]
[illegible] [illegible] [illegible] [illegible]
[illegible] Constitution [illegible] [illegible]
[illegible] [illegible] [illegible] [illegible]
[illegible] [illegible] me, I am in want of many
[illegible] [illegible] moments.

Awaiting & hope for an immediate
answer I remain

Yours Truly,

Benj. Smith Lyman.

[illegible] 1870

[illegible] Office in charge of Furniture,

[illegible] Cuba.

Sir:

If you would conveniently lend me the following pieces of furniture [illegible] be a great accommodation.

1 Large [illegible] table.
2 [illegible] lamps.
1 [illegible] for [illegible]
[illegible]
Bedroom furniture [illegible]
2 [illegible]

[illegible]
[illegible]

Ledo; 18 Nov. 1873.

My dear Father:

I have to thank you very much for your favor of the 24th of June received on the 26th of September, and for another of the seventh of September received yesterday. After receiving the former there was as I understood no chance to send an answer earlier than my own coming from Yezo; and for that reason also I brought with me a letter [illegible] to Mary. I am delighted to hear now of your having resigned your office, and trust you will find the relief agreeable. You will I hope pardon me if I venture to set down what you say of your presentiments in regard to the shortness of life as not having any very good foundation and to trust that you will yet enjoy many a year of quiet and I hope happy repose free from care. As far as income is concerned I am sure that I should be delighted to do what I can to make up any deficiency that may arise from the loss of your salary or from the increase of taxes; and from present appearances there will be no difficulty in my doing so. I hope that the present financial crisis that we are just hearing about and that seems to make so much trouble to the banks may not cause any losses either temporary or permanent to the funds you are interested in; but even in that case I may perhaps be able to make them good as far as you are concerned and it would certainly be a pleasure to do so. — When your former letter came I was approaching Hakodate, and after that was nearly all the time within a day's ride or two of that town. But there were many points to be visited at least hastily; and I [illegible] around the peninsula to the east of Hakodate and then spent a week to the westward of the same town, and finally a week at Hakodate waiting for Mr. [illegible] to come in with his party and for the steamer to [illegible]

60

Lab: 18 Nov. 873.

My dear Pastor:

[illegible]

The Ariel which we had expected to sail in was wholly lost on its trip from Yokohama to Hakodate; and we came in a Russian steamer, the Courier, which happened to come along just then. It is a vessel that goes every year to the Kurile Islands and Kamtschatka cruising about to many ports picking up furs. The owner of the vessel Mr. Philippers was on board, a Russian as well as the Captain; but both talked English (and German too) remarkably well, and had been much in America. Besides that there was a German merchant from a Russian port two days sail west of Hakodate who had also been in America and talked English extremely well. The other passengers besides our party were all Japanese; and it was something exceptional for the steamer to carry passengers at all. According to their habit they burnt on the voyage very little coal, only six or seven tons a day (the steamer was one of ten or eleven hundred tons) and we were four days on the [illegible]. Luckily the weather was pretty fair almost [illegible] time and the water smooth for the most part so that I was not once downright sea sick and got along well enough without a state room. (The empty lamp persists in going out, so I must finish this in the morning) — [illegible] — On arriving in I took possession again of the same rooms I had [illegible] and am gradually getting them put to rights and properly supplied with furniture, which the Kaitakushi still lends in part in spite of not having moved to furnish it. On the other hand I still [illegible] to provide [illegible] agreed and lets these few rooms pass as such. The assistants and I intended to present ourselves in a body to Mr. Kuroda the morning after our arrival (we got here Friday night); but found that "Government affairs" so occupied him that he could not be seen. The fact is that [illegible] changes are going on in the government [illegible] that [illegible] has got back from his Embassy round the world, and the affairs [illegible] are said to be undergoing investigation. It is [illegible] the Kaitakushi has spent ten million dollars in the last few years [illegible] revenue, and has little or nothing to show for it except [illegible] engineering works, [illegible] piers and floodgates in absurd places, [illegible] certain individuals have [illegible] their [illegible] all night and has all along complained that he [illegible] in which so [illegible] American [illegible] and other [illegible].

[illegible]

Feb. 1 [illegible] 72.

Dear Mary:

A few days after writing you the accompanying letter I was much pleased to receive your favor of the 22nd ult. and duly paid [illegible] and made [illegible] to Plumber and Steamfitter. I am very happy [illegible] to late letters not having reached us in London since [illegible] and that [illegible] is always in a [illegible] way [illegible]. [illegible] I [illegible] and [illegible] all along [illegible] and [illegible] would [illegible] [illegible] [illegible]

in Texas should send me his card, but even a news of the gift did not reach me until the day of my arrival at Galveston. We dined on the 5th Mr. Hunt & I at the same table for which I also take some credit as having taught him as well as the other associates — & work pretty hard. Indeed they have all done very well and on their return to Hartford [illegible] Mr. Hunt & I are then in good season to be present at the completion of their handsome & useful Asylum. Then a pedestrian tour in which I visit their relatives and visit [illegible] and eventually Hartford. Even laboring men in Texas are supplied [illegible] with their bottle at dinner — You will be amused to learn that most of the servants are Negroes. They do your washing & eat the same food as the Masters when you are in America as well as in Europe. I do, of course, in the only sense in which the words in my former letter could be taken. We are using the interpreter [illegible] you observe & feel when there. It is hardly intelligible.

I [illegible] by taking [illegible] lessons and lounge in Germany. Often my good natured landlady; that is carrying the thought of economy a little too far. It would seem. He would not have been still better pleased to meet with a woman [illegible] in reality [illegible] and the power of doing himself the vanity of learning by [illegible] a conversation. He might perhaps have been gratified & learned to say it was by obtaining from such models more food & amusement a dance of Kisses but [illegible] so many hundreds among [illegible] Mathematical Students. Many thanks for kind information as to the physicians believe on the subject of food and climate backed up by Mr. Delamotte's opinion; [illegible] conversation would have been equally grateful when you [illegible] heard read. [illegible] I shall [illegible] think my own opinions on this matter [illegible] any physician younger than myself [illegible] his consideration and few physicians [illegible] their opinion about it after the age of [illegible] [illegible] [illegible]

[illegible]

Weida, 24 Aug. 1761.

To the Rev. Mr. Lewis

[illegible]

Sir

[illegible]

I enclose herewith a list of the Names of the Negroes needed, and beg that they may be sent down to me with the least possible delay, as it is most important that we should get in the crop, before it is quite too late.

[illegible]

[illegible]

[illegible]

List of Chemicals and of Apparatus
Needed by Mr. Munroe.
[illegible]

For Assays and Analyses:

[illegible] with shelves for reagent bottles and drawers and [illegible] sliding doors and locks [illegible] made according to Mr. [illegible]

2 dozen glass stoppered reagent bottles, two sizes, one dozen [illegible]

Supply of [illegible] reagents

[illegible]

[illegible] flasks

[illegible] measuring flasks

[illegible] of [illegible] tubes.

[illegible] tubes.

20 combustion tubes.

1 Cascade.

6 evaporating dishes.

2 [illegible] stands.

1 spirit lamps.

1 [illegible]

1 water bath

2 pounds glass tubes, [illegible]

[illegible] pound glass rods.

1 platinum crucible.

[illegible] doz. [illegible] tubes.

1 [illegible] tube stand.

[illegible] covers.

[illegible] watch glasses

12 funnels.

12 porcelain crucibles.

1 quire Swedish filter paper.

200 assorted [illegible] filters.

1 gross corks.

[illegible] rubber tubing.

2 [illegible] bulbs.

10 rubber corks.

4 pieces coarse wire gauze.

2 assay furnaces to be built according to drawings to be [illegible]

For Lecture in Chemistry:

Sulphur
Tin
Vermilion
Zinc
Turpentine
Glass
Iron sulphide
Marble

Apparatus [illegible]
[illegible]
2 tall glass jars
3 bell jars
1 galvanic battery
2 gas bags
3 safety tubes
2 [illegible] bottles
4 large glass jars
[illegible] plates, [illegible] tumblers, [illegible] glasses.
[illegible] and [illegible] jars
Candles.

For Blowpipe Analysis.

For immediate use
3 dry [illegible] bottles [illegible]
[illegible] glass [illegible]
[illegible]
3 watch glasses
3 " small [illegible]
3 " test tubes
1 " funnels
1 " small flasks
Filter paper
6 or 7 small hammers
3 or 4 agate or glass mortars.

For use [illegible]

3 complete nickel plated [illegible] blowpipe apparatus made by Single with balance and box and supplies.
For each assistant one [illegible] set of blowpipe apparatus for qualitative work.

Tokio, 25 Nov. 1870.

To the Hon. K. Kuroda,

Dewan of the Kaitakushi

Sir: The room No. 8 in the school building of the Kaitakushi has been shown me as the one where the zoological assistants can carry on their mounting and other office work; and I have [illegible] on account of its size [illegible] belonging with it. Yet the light is not so good as necessary for fine drawing, and I beg to [illegible] a roof [illegible] useful in the [illegible] windows, but unnecessary now [illegible] is removed, as I understand from the Kaitakushi Carpenter [illegible] it could easily be done. By [illegible] means much additional light would enter the windows and the room would be very satisfactory for our purpose. At the same time our leaving it as it would make room for the domicile of the Day as proposed at first.

Hoping that you may find it right to order the removal of the veranda roof in question, I have the honor to remain,

Sir,

Your most obedient servant

Benj. Smith Lyman.

and without the least public competition and
before you could deliberate as to the best method of
disposing of property of a kind so much sought
after by capitalists. Even if you had any
reason to desire such a transaction the public
outcry would very justly be too great. But his
visit prompts one to ask whether there be any
objection to my giving in like manner freely
to any body who desires it whatever information
I conveniently can in regard to the minerals
of Yerso. It is the custom to do so in the public
surveys of other countries and seems to me
unobjectionable here. On the other hand I beg
most earnestly that no other or given it had
to any body whatever any of the unfinished pieces
of the survey; the damage of their getting misc-
laid and lost and of being absent at the time
when wanted is far too great.

I have the honor to be,

Yrs

Your most obedient Servt

Benj. Smith Lyman

Preliminary Report

on the

First Season's Work

of the

Geological Survey

of Texas,

by Benjamin Smith Lyman

25 Dec. 1873.

Preliminary Report on the Third Season's Work of the Geological Survey of Iowa.

	Page
Nature of the Survey	1
Limits of Survey	1
General Plan	2
Fossils	1
Topographical Method	1
Advantages for studying the Geology	4
" " setting forth	5
Surveying required of the Geologist himself	6
Assistants	7
Their Good Behavior	7
General Nature of their Work	8
Benefit of the Work to them	9
Instruments	11
Office Work	12
Choice of Points to Survey	13
Economy of Geological Surveys	14
History of Operations	15
End of April to 1 July	15
1 July to beginning of October	17
Beginning of October to middle of November	19

Pg.
Geology of the Region Investigated 22
Alluvium 22
Sand 22
Clay 22
Volcanic pebble Rock 24
Volcanic Rock 25
Tothibets Kurrupt System 26
Coal Bearing Rock 28
Horumei Kurrupt System 29
Tothibets Kurrupt System 29
Economic Geology 31
Coal 31
Kayasama 31
Elevation and Geology 31
Coal Beds 32
Shipping 33
Tramway 33
Harbor 34
Horumei 35
Elevation and Water 35
Geology 36
Coal Beds 37
Shipping 38
Kudowa ..... [illegible]

[illegible] 61
[illegible] 61
[illegible] 61
[illegible] 61
Rock [illegible] 62
[illegible] 62
[illegible] ..... [illegible]
[illegible] ..... [illegible]
Mineral Springs ..... [illegible]
Table 67
[illegible] 77

Shibu, Feb. 25th 1878

Prof. Hon. Dr. K. Kakoda
Jibunan of the Kaitakushi.

Sir:

My orders on leaving Sapporo were to
report to you fully at Lib's in regard to the
next season's geological work in Yezo. As it
will take some time yet to work up the
[illegible] and set them forth in maps and full
reports I hasten not after arriving at Yezo
to give you a sketch of what was been done, its
nature and its probable results.

The work according to your instructions
has been confined to the four southwestern
most provinces Oshima, Shinibets, Hurai
and Ishcari, about one third of the island
indeed only the lower part of the province of
Ishcari was visited, by the direction of Gov.
Matsumoto; since nothing of mineral value
was reported from the upper waters and it
would have taken three months or more to
[illegible] them, and there was little prospect of

ing much of geological interest without making
addition long and difficult excursions away
om the almost unvarying alluvial plains
at border the river itself.

Within the region examined the aim has
en to learn something definite in regard to
few important points at least, rather than even
go over much more ground and obtain only
gue and wholly important information since
is certain that the one method gives results
times more valuable than the other. All
laces, however, where useful minerals were
ported to exist have been visited with scarcely
single exception, even though they often proved
be worthless either in quantity or quality and
passing from one point to another an effort
s been made to learn as far as possible
general geology of the region aside from the
seful minerals merely.

For this purpose also a number of fossils
have been collected at several places; and
ey will probably be useful not only in the
ognizing rocks of the same age at other points
Less, but in determining their age as some

pared with the rocks of the rest of the world, and so possibly enabling conjecture to be formed sometimes of the quantity and quality of certain minerals they are likely to contain. A more minute study of the fossils is of great interest to palaeontologists and of great value for the progress of learning, and I would urgently recommend placing the collection in the hands of somebody specially skilled in such matters to be studied, described and published. As our libraries here in Japan are so defective in this branch of learning I say nothing of the lack of a man well skilled for the study it would probably be best to send the fossils abroad. There are yet so few fossils and too little knowledge of large collections of the number hardly justifies the employment here for the present at least of a foreign palaeontologist for these alone. For the education of the youth of Japan in general it would however no doubt be desirable to have such a foreigner come here, and if one should come, these fossils might be entrusted over to him.

In the survey the American Transylvanian topographical method has been used for the creation and improvement of which not only in its working details on the small scale, but the discovery of its general laws on a large scale geology owes so much to Professor J. Peter Lesley of Philadelphia, as I had the honor of showing about two years ago in a paper read to the American Institute of Mining Engineers. That method is indeed, as compared with others in geology what quantitative analysis in chemistry is to mere qualitative analysis, and is no less important for theoretical purposes than it is useful for practical ones. It strives to determine the extent and position of mineral deposits both underground and at their outcrop by means of laying down on paper the shape of the surface of the ground (by contour lines) as well as all the dips and strikes of the rocks that can be observed, so that the contour of any rock bed or vein may be drawn as it is even underground and its contents above or below any given level or within any given limits may be

calculated. In short the surface and the deposit are geometrically constructed on paper. Of course, just as a chemical quantitative analysis may be more or less exact according to the instruments used or according to the difficulties of the case, so these geological surveys are only roughly exact when poor instruments are used or when the case is specially difficult; but almost any case are far better than merely qualitative observations alone. They are in fact as far as they go definite and precise while ordinary geological surveying so called gives vague and conjectural results, just as the qualitative analysis of a mineral enables the quantitative composition only to be guessed at.

The topographical method moreover gives by its maps very much the best means of compactly and clearly setting forth to others observed geological facts and the conclusions arrived at. From such a representation of the facts inferences can readily be drawn by others independently of the observer's opinion — con-

firming or offsetting his judgement. The results of the Reader's work then will be not merely personal opinions but facts so gathered and arranged that in future any other geologist can form his own conclusions from them with no need of revisiting the ground unless a more detailed survey should be desired.

A quantitative measurement naturally requires much more time and work than a mere qualitative one, and that has hindered the more general adoption of Lesley's method in countries where time and work are dear, in spite of its abundantly counterbalancing advantages, and has even caused professed geologists to remain in ignorance of it and of its merits. There is perhaps no country in the world whose surface has already been topographically mapped minutely enough to answer in a detailed measurement of the rock depths, and only few countries which have been mapped well enough for somewhat more general geological purposes. It is therefore necessary

for the geologist to undertake the mapping of the surface as well as of the underground features; and he can do it better for his purpose than a mere topographer because his work is guided by the geological structure.

The assistants you kindly furnished me have added very much to the amount of work that could have been done by any one man; even though they were young and inexperienced and for the most part wholly ignorant at the outset not only of geology but of surveying, drawing and even almost of common arithmetic. They have been very useful, partly because they have eagerly and rapidly learned what they could in a very short time, and partly because such duties as require much work of a comparatively simple character.

Mr. Henry S. Munroe, the American assistant, was by his former studies much better fitted than the Japanese assistants for undertaking such work, although it was in great part practically new to him. He entered on it with interest and intelligence and

has worked industriously and faithfully. He was especially useful at first in teaching the others drawing, and in the field has had charge of the details of the work of one half of them and the whole management of the gold surveys under very general instructions. Of the Japanese assistants Mr. T. Yamauchi by his greater age and therefore more advanced education and matured judgement has easily stood at the head. Mr. H. Satow, besides his remarkable success as interpreter and his good service as an assistant in surveying has with admirable zeal made for us an excellent botanical collection. My quartermaster since August, Mr. T. Akiyama, from mere love of learning frequently made himself very useful also in surveying though it was quite outside of his required duties to do so. He has therefore more than replaced the single assistant whom it was found necessary to dismiss. Mr. Munroe's quartermaster Mr. S. Ichichi has kindly improved the opportunity of his abundant leisure on the Toshibets by making an interesting collection of insects. All the assistants (including besides those already named, Messrs.

Inagaki, Kuwada, Mitsawa, Takahashi Kata
saka and Saito) with a laudable desire to do
even more than their mere duty and I be
forward the interests of the survey and with
eagerness for their own improvement have
done more than could be reasonably exacted
from them, or at any rate in addition to
bearing many hardships cheerfully have
worked harder both bodily and mentally
than even laboring men in Japan are com-
monly expected to work with their bodies a-
lone

I have tried to turn the assistants' services
to the best account by giving them the simpler
but more time taking work to do, while I my-
self (after they had had a few weeks practice)
visited a larger number of places more rap-
idly and attended especially to purely ge-
ological observations where either little other
work was required or where it was done by
the rest.

Besides the aid they have given, notice should
be taken of the benefit to them and to the em-
pire of the knowledge these Japanese have

gained by their season's labor. They are not only the first Japanese but the first Asiatics to take the study and practice of geology, and although the training of native geologists in India has been begun nearly at the same time (or is soon to begin) I trust that ours will continue to take the lead, and that Japan will become in a few years independent of foreign countries in their profession. The young assistants have not only learned something of surveying and geology, but have in the field work had under them each two or more laborers for rod men and choppers and have therefore gained a little experience in the management of men, a matter of very great consequence, if they are ever to be put in charge of important mining works. It is, however, a matter to be wholly neglected in the training of the young men in all but the military schools of foreign countries although quite as needful in civil or mining engineering or in agricultural affairs as in military.

On account of the shortness of the time

[illegible] and [illegible] [illegible] [illegible]
[illegible] [illegible] [illegible] [illegible] [illegible]
[illegible] [illegible] [illegible] [illegible] [illegible]
[illegible] [illegible]

13

14

sufficient exactness by the time the whole of Yesso should have been gone over on the present system. In regard to the general geology of the field of this years work some important points remain still undetermined, such as the relative age and the superficial extent of certain groups of rocks; but some of them will perhaps be made known by the winters mapping while others may be cleared up by the surveys of other parts of the island, or may possibly require special examination at some future time

Many places were visited where valuable minerals had been supposed to exist, but where they proved to be deficient either in quantity or in quality. Indeed on the island of Yesso as almost everywhere else the chief directly practical benefit of a geological survey is far more in saving the expence of foolish outlay in mining worthless deposits than even in guiding productive work; and much money would have already been saved in Yesso if some

petent men had long ago been employed to examine the deposits properly and authoritatively discourage the working of mines whose ruins now remain as marks of the hopefulness of human nature. This hopefulness here as in other countries leads most men to the ruinous belief that the part of a deposit that is hidden deep within the earth is better than the part exposed near the surface; so that good deposits are sure to be worked however unskilfully even without the recommendation of a geologist; while bad ones are apt also to be tried until his advice puts an end to further waste of money. It would be very interesting if the millions wasted all over the world in foolish mining that would have been prevented by a good geological examination could be compared on the one hand with the perhaps hardly greater profits of successful mining and on the other with the relatively trifling cost of such a survey.

On coming to Yesso towards the end of April we went at once to Sapporo according to the instructions given at Yeds; expecting to begin

[illegible]

at that time the survey of the ~~[illegible]~~ ~~geologically~~ country to the north hitherto geologically unexplored. But owing to the reported high stage of the Ishcari River we were directed to go first southward for forty or fifty days to the coal mines at Kayanoma and its neighborhood. After finishing the coal survey I sent Messrs. Munroe, Satow, Inagaki, Misawa, Kada and Saka still further southward to make a somewhat detailed survey of the Toshibets gold region against my visit there in September, and then to go on towards Hakodate; as they afterwards did, making rapid surveys of the small gold regions near ~~at~~ Kudow and Esashi and of the lead mines at Turap. The other five assistants and myself arrived again in Sapporo at the end of about fifty days having visited the gypsum at Tunai in the Raiden Mountain (apparently too poor to work); the zinc blende, galena and copper pyrites vein near Tudomari and Sakkadzuki (quite too thin to work); and the place of the supposed [illegible] at Furubira (merely a lump of coal that had been brought no doubt by some boat or by the hand of a man and dropped on the river shore). On the way more

17

our, according to instructions, we went quite around the Shakotan peninsula, without however hearing of any minerals of economical importance; though we had an interesting view of the rocks as we passed along, sometimes by land where there were roads, at other times by sea. After a week of office work and preparation we set out from Sapporo for the coal field on the Horumui, a branch of the Ishcari; from a rapid survey of which we returned to Sapporo in just a month, after many needless delays and hardships occasioned by the neglect of duty and incompetence of the quartermaster then with us.

From Sapporo I sent Mr. Yamauchi and the three other assistants then left with me to Horikap to make a small addition to the Kayanoma survey against my revisiting that place in company with Genl. Capron; and myself visited the blende, galena, pyrite and orpiment place (worthless as it turned out) near the Jozan hot springs on the upper waters of the Tayahira; and afterwards according to instructions [illegible] accompanied Genl. Capron to the

[illegible]

mouth of the Ishcari, to Tobets, and then Iwanai Horikap and Kuyanoma, on the way visiting the pyrites place near Rubeshibe, which proved however to be quite insignificant. After inspecting the work of the four assistants at Horikap and making a survey of the Chatsunai and Shibui harbors and a visit of exploration across the mountain to the Furubira River, I took the assistants to the Iwaonobori sulphur place, and made with their help a hasty survey of it. From there I sent them to begin surveys at Yamuakushinai and Washinoki; while with Mr. Akiyama I went myself across the Sheribets valley to Usu on the East Coast, and visited the sulphur place there, which turned out to be wholly unimportant. We went thence still further north eastward along the coast to the sulphur place at Nuburibets Hot Springs, and then to the one on the top of Tarumai volcano. Returning southwestward we visited somewhat discovered ores of zinc, lead and copper on the Horobets, and found them too poor to work, and also investigated a reported discovery of coal at the mouth of the Washibets near Mororan.

[illegible] to [illegible] the [illegible] lumps of [illegible] had been washed [illegible] from a [illegible] [illegible]. Then following the [illegible] as far as [illegible] we went to the gold mines in the [illegible]; but as Mr. [illegible] had [illegible] with his party to the Kadav gold [illegible] by some mistake had left none of his mapping behind and no special [illegible] in regard to the surveys he had made after a day or two of examination of the gold washings we went to Yamukushinai. Here with the help of the rough mapping of Mr. Yamauchi's party the oil place and the [illegible] ore sand of the beach were examined and the daily yield of oil was measured.

From Yamukushinai Mr. [illegible] and I made a short trip to the old lead mine of Yuraf, and left somewhat detailed instructions in regard to the survey to be made there by Mr. Munroe and his party. Thence we went to Washinoki visiting the Bora and Kusuri Hot Springs while passing Otoshibe. At Washinoki the oil place was visited and the geological observations of Mr. Yamauchi and his

party were ~~~~ reviewed and their other work just then finished was inspected. They were then sent to Idzumisawa to make in like manner a map of the oil place there. Mr. Akeyama and I fixed the position of the Washinoki lime=stone, visited the Nigorikawa Hot Springs and the Torizaki insignificant lignite and oil gas, all near Washinoki. Then going southeastward along the shore we visited the Tomi Hot Springs near Shikabe; the sulphur place (unimportant as it proved) on the top of Komangadake; the Shikabe hot springs; the Isoya hot springs; ~~the~~ ~~~~ the Kemushitomari lignite between Isoya and Kumadomari (found to be quite unworkable); the Obune Hot Springs; the Kakumi hot springs; and the Esan sulphur mines of some importance. Then turning southeast=ward and westward along the shore towards Hakodate we visited the Kobui gray sulphur mines, the Kobui Oran sand; the Setarai worth=less pyrites and calc spar; the Ishizaki lime=stone; the Yunokawa hot spring; the Yunokawa kaolin; the Kami yunosawa limestone and hot spring. Then westward from Hakodate we visited

the Idzumisawa (or Kamaya) oil spring, and with Mr. Yamauchi and his party reviewed their geological observations and inspected their whole survey at that time about finished. Then we visited the Moheji kawa brick kilns and clay pits; the Tomigawa lignite (quite unworkable, as it proved); and the Ichinowatari long abandoned lead mines (very justly abandoned as it seems). Then with Messrs. Yamauchi and Takahashi we visited the very abundant limestone of Garonosawa; and on our return were joined by Messrs. Kuwada and Saito and we all came to Hakodate on the first of November, the field work all done. The next day was very stormy and much snow fell at the Kuraji mines where Mr. Munroe's party had been working; and they all hastened in accordance with my instructions to Hakodate. They arrived on the seventh; on the ninth much more snow fell even around Hakodate; and on the tenth we all sailed for Yokohama and came directly to Yedo.

The part of Yezo we [illegible] so far [illegible]
in the following groups of rocks
Alluvium, new and old
Volcanic [illegible] rocks
Volcanic rocks.
Rocks of the [illegible] Kraft System of Folds
Coal bearing Rocks, or Rocks of the Horumui Kurile System of Folds,
Rocks of the Horumui Kraft System of Folds
~~Rocks of the [illegible] Kurile System of Folds~~

Alluvium. — Along the Tokari River are rich
lluvial plains in all about fifteen miles (six
) wide and forty miles (sixteen ri) long, and
milar smaller plains are found [illegible]
large streams, the Shiribets, [illegible]
ver, Horikap, Yurap and many others not so
ge, making admirable farming sites, only
the lack of roads at present. The soil [illegible]
mo generally to be very good even on the uplands
d supports a rich growth of wild plants. The
ief exception is in the neighborhood of Tarumai
lcano where for many miles around even
low plains by the sea shore have so lately [illegible]
ered by pumice as very much to lessen their
tility. Yet even here a rich black soil, in some

places [illegible] thick exists at the depth of only about a foot below the surface of the ground.

On the [illegible] the Toyahira and elsewhere beds of lignite and peat three feet or more [illegible] are exposed in this alluvium, very recent looking lignite with the woody fibres and form plainly seen. This lignite is also found in bits on the Thiribets and in the Turubira. At Kobiri there are eight feet or more of peat.

A somewhat older alluvial deposit almost everywhere along the coast forms gently sloping plains from a few yards wide to several hundred between the mountains and the seashore often spread out in fan shape just outside the mouth of narrow valleys; and as it has been eaten with by the sea it forms bluffs in many places. The bluffs are not by any means always made up wholly of the alluvium, but often merely capped by it. The height of the top of the bluffs is often pretty uniform for a good distance, but varies in different places from a score of feet to a couple of hundred. Such gently sloping plains at the top of bluffs have been called marine terraces in Messo, and their materials a terrace deposit.

1.

but bluff deposit would perhaps be a better name 24
True marine (or lake) terraces seem to have been
found nowhere on the shore except two or three
one above another near Hakodate, especially
at Idzumisawa. If they were caused by dif-
ferent stages of sea level it would be strange
not to find similar terraces on other parts of
the coast. Possibly therefore the sea between
Yesso and Nippon (either in part or wholly) was
once a closed basin with the water standing
successively at different heights. The rocks that
chiefly make up the terraces are much older and firmer
than the loose alluvial matter with which they
are covered, so that they may have [illegible]
time when the outline of the land was so very
different; and volcanic action may have hastened
the changes.

Volcanic-pebble Rocks. — Much of the wes-
tern part of this portion of the Island is covered
with rocks that are chiefly made up of pebbles
of volcanic rocks. Such pudding rocks are found
especially in great thickness around Iwanai
and along the coast northward around the
Hakotan peninsula. The pebbles (sometimes

24

[illegible] would perhaps be a determinant
True marine (or lake) terraces seem to have been
found nowhere on the above except in or that
are above another near Hakodate, especially
at Nyamiyama. If they were caused by dif-
ferent stages of sea level it would be strange
not to find similar terraces on other parts of
the coast. Possibly therefore the sea between
[illegible] and [illegible] (either in part or wholly) was
once a closed basin with the water standing
successively at different heights. The rocks that
chiefly made up the terraces are [illegible]
than the large alluvial mantle with which they
are covered, so that they may have [illegible]
[illegible] the outline of the land was so very
different; and volcanic action may have [illegible]
the changes.

Volcanic pebble Rocks — Most of the [illegible]
[illegible] portion of the island is covered
with rocks that are chiefly made up of pebbles
of volcanic rocks. Such pudding rocks are found
especially in great thickness around Yamanai
and along the coast northward around the
Hakodate peninsula. The pebbles, [illegible]

[illegible], even three feet) are of various [illegible] and [illegible] different from the finer sand like materials in which they sometimes lie embedded, and they are often very much rounded as if by water. These beds of rock have been called "tufa conglomerates" but would seem rather to be the result of the wearing away of volcanic rocks by water. They have much the same dip as the coal bearing rocks, or even steeper and rest perhaps conformably on them.

Volcanic Rocks.— The volcanoes that have within historic times been in action or that still have active sulphur vapors seem to be mostly along the shores of Volcano Bay and the adjoining coast. Beginning at the north there are Tarumai, Nuburibets, Usu, Komangadake, Esan; and besides there is Iwaonobori near Iwanai on the West Coast. Of these Tarumai had a small eruption about the first of March (20th of 1st month) 1867, and a larger one seventy years before, both of pumice; and Komangadake one on the 23 September (26th of 8th month) 1856 also of pumice; the only pumice volcanoes met with, and the only ones that have been active within historic times. They are about 55 miles apart. Besides these partially active volcanoes are many

[illegible] that seems to have long been quite extinct.
[illegible] highest, most symmetrical and beautiful of
them all is Shiribets Mountain perhaps 6000
feet high above the sea, and almost a regular
one. It stands fifteen miles (six ri) southeast
of Iwanai half way between the two coasts,
either one of which has here for some distance
a nearly circular outline with that moun-
tain for the centre. Possibly old eruptions of
the volcano may have had an influence on
the position and outline of these parts of the
coasts though it is not obvious upon a cursory
examination of the rocks and topographical
details. A large part of the rocks of the southern
end of the Island, say from Sapporo southward,
are volcanic, oftenest porphyritic in structure
and several old ruined craters apparently are
still to be seen, as for example on Hakodate
Mountain.

Toshibets Karaflo System. — At the
Toshibets gold field, and further southward are
rocks with dips from 50° to 25° or even less with
axes bearing north five degrees east (magnetic)
or thereabouts. These rocks contain on the Toshi-

[illegible] at Guraff, Idgumisawa and Sendere great
[illegible] of the [illegible] of tuberosus, and
other plants are very [illegible] looking [illegible] that
seem [illegible] group of rock; [illegible]
moreover mostly soft and very new looking [illegible]
the rocks of that group at Tomigawa across the
harbor from Hakodate are two or three thin beds
of earthy brown compact lignite much newer
looking than the Kayanoma and Horumui coals,
though much older than the lignite found in various
places in the alluvium. This folding may con-
veniently be called the Toshibets Kaufte system;
for the sections of the Toshibets survey will probably
show the rocks folded by this system more fully
than any other. Mr. [illegible] thinks that they
have there a thickness of three thousand feet,
with reddish brown soft sand rock at the bottom
but above that almost wholly greenish gray soft clayey
sand rocks or sandy clays with some balls of
limestone near the bottom and here and there in
the places bands of pebble rock. This des-
cription, except the red rocks at bottom, answers
closely also for the rocks of Idgumisa-
wa.

Coal Bearing Rocks. — The productive [illegible] coal measures both at Kayanoma and on the Horumui have axes running about north fifty degrees east (magnetic) with dips of thirty degrees to sixty degrees, steep on the northwest side at Kayanoma, and on the southeast side on the Horumui; and seems to be of comparatively recent age, perhaps tertiary, from the appearance of fossil leaves on the shales. A number of fossil shells found in the Horumui field will perhaps determine the age more exactly. The coal very much resembles the coal of the Rocky Mountains of about the end of the cretaceous and beginning of the tertiary. At Kayanoma the coal bearing rocks seem at the edges of the field to be overlain by the volcanic pebble rocks; the underlying rocks have not been seen. In the Horumui field the coal measures seem to be underlain by rocks of the Horumui Karafto system of folding. The coal rocks of the Kayanoma field are mostly light gray shales, with but one exposure of limestone, a three foot bed. In the Horumui field the rocks are mostly blue gray shales having in certain parts balls of limestone with fossil shells; but no bed of limestone was found

28

[illegible]. The close parallelism of the axes of the coal rocks to the trend of the Kurile Islands seems to justify the convenient name of Horumui Kurile system for the folds.

Horumui Karafto System. — The rocks just mentioned as seeming to underlay the Horumui coal have a nearly vertical dip and a strike of north three degrees or five degrees east (magnetic). They are at least six hundred feet thick, and are bluish gray shales and pebble rocks coarse and fine, all much older looking than the coal rocks, as if somewhat metamorphosed. The pebbles of the pudding rocks are of granitic, syenitic, or other ancient crystalline rocks, such as are not seen at all in the overlying beds. No fossils have yet been found in these older nearly vertical beds. The close parallelism of their strike to the general trend of the Island of Sagalin (Karafto) and of the northern part of Nippon is very noticeable and seems to justify giving to such rocks folds the name of the Horumui Karafto System.

~~Tohibeto Karafto system.~~

~~At the Tohibeto gold folds and further.~~

Near the Tomigawa lignite of the Tohibeto Karafto system is the Tarumawa limestone,

a much older looking rock much broken up by cleavage planes and apparently much metamorphosed. It would seem therefore to be of nearly like age with the vertical rocks of the Horumui; while the more recent looking rock near it of similar strike would seem to be newer than the brown coal measures and to have been folded by a later action than that of the Horumui Kerafto system though nearly or quite in the same direction.

Toshibets kurile System. On the Toshibets Mr. Munroe found in place ancient looking syenite generally quite soft, in place which had a bleicher nearly northeast and southwest with nearly vertical dips. Pebbles of similar granitic rocks are found on the headwaters of Kumumi River and perhaps elsewhere. If these be really (as they seem) older than the rocks of the Horumui Kerafto system to which they probably furnished the crystalline pebbles, the folding of the rocks of the island would seem to have been twice alternately about northeast and about northerly in direction, and the folding of these crystalline rocks may be said to belong to the Toshibets kurile system.

If course the same system of folds might affect rocks of very different age: but no more precise determination of the relative age of the rocks has yet been made, still, the thickness of the rock belonging to each system is not very great and each group has throughout an appearance so uniform that there is probably no very great difference in the age of their different parts.

The useful minerals of chief importance in the field gone over this year are: Coal, iron sand, sulphur, limestone, gold, rock tar and mineral springs, and traces of silver, lead, zinc, manganese and copper.

Coal. — The Kayanoma Coal Field is about seven miles (three ri) north of Kyanai, and one mile and a half (half a ri) from the sea shore and covers half a square mile or so (say 400 000 tsubo). The beds of rock lie in the form of a saddle running nearly north fifty degrees east (magnetic), the axis passing through the Shibui valley. The coal at the present mines dips steeply (fifty degrees), but in other parts of the

[illegible] the [illegible] [illegible] [illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

The present mines are about two miles [illegible] from the sea shore at the present shipping place at Kayanoma. [illegible] these are very much exposed to the [illegible] on a dangerous rocky shore; and special attention was given to the question of shipping the coal elsewhere. Our maps will probably show the possibility of building a tramway with ease and without tunnelling from the neighborhood of the present mines to the Shibui Harbor close to Shotsunai, less than two miles distant in a straight line. Such a road would start from the lowest natural drainage level of the bed now mined, much lower than the present mines and near the foot of the second inclined plane, and doing away with the third also would with a very gentle down grade pass along the hillside and over the lowest gap in it and then descend more rapidly to the shipping place. If the last descent should prove so steep as to require a plane it could perhaps be so arranged that the loaded cars should draw the empty ones to a little greater height than the bottom of the gap so that they could run all the way down hill to the mines again. Coal

has also been opened at several points in the Chalcedonian valley, thus about two miles from the harbor, and one of the beds [illegible] of coal [illegible] but thirty degrees. [illegible] easily be built with a [illegible] down grade from this coal all the way to the harbor.

The harbor at Chalcedonian is however very small though well protected, and the deep water of Shibai harbor close [illegible] still [illegible] in extent. [illegible] 375 feet long in water at most twenty-five feet deep [illegible] from the northern head of Shibai harbor to the north end of an [illegible] ledge of rocks, and some 250 feet more [illegible] this ledge with other smaller ones in line with it would make a land locked harbor of about six acres of water twenty-five feet or more deep, and give protection to about ten acres of the depth from all quarters except about thirty degrees west to southwest by westerly [illegible] much more from the northwestern storms of winter. It seems an unusually good place for making an artificial harbor; the breakwater would be not only in shallow water but very

short in comparison with the surface protected, the stone for building would be in the cliffs at the very starting point of the breakwater. The entrance to the harbor would be wide, deep and easy, and the only streams emptying into the harbor are two small brooks which could not silt it up. On the other hand the Awanui poorly sheltered harbor is the next best resource, and it is four miles distant from the coal and separated from it by the Horikapa River and the hill next it. To the foot of this hill however the country is flat, and a tunnel of perhaps only a thousand feet would reach a thick bed in the Whatumai valley from the Horikapa side.

The Hokianga Coal Field near the head waters of the Hokianga and about twenty seven miles (eleven ri) east northeast of Kopo Kopo is part of what would seem to be a very large field. Our Railway this year went on a portion of it only about three miles (¾ ri) long by half a mile (seven cho) wide, because that seemed enough to show what part of the field was near the navigable water of the Hokianga, and what it would be best to open mines there for.

some the surveyed coal lies about a dozen miles (five ri) in a straight line from the Tokcari river and is separated from it chiefly by a level plain. We did not see the northeastern end of the field, indeed information was given some months after our departure that coal was known to exist on the Sorachi river some twenty five miles (ten ri) to the northeast, almost certainly a continuation of the same field, since the general strike of the coal is about north fifty degrees east (magnetic). Coal is also said to be found on the south side of the mountains between the Horumui and the East coast and quite likely it belongs also to the same field. In that case there would seem to be an area of some thirty miles (twelve ri) in length by perhaps as much in breadth.

In the portion we traversed we found the beds to lie in the form of a saddle running (as at Kayanoma) about north fifty degrees east (magnetic) with a steep dip of some sixty degrees on the south east side and a gentle one of say forty five degrees on the northwest side. No rocks are exposed above the coal bearing rocks within the

[illegible] of the coast passing, [illegible] underlying rocks [illegible] are disclosed in the cliff of the neighboring [illegible] and are clearly [illegible] to the [illegible] [illegible] [illegible]

We have [illegible] a number of [illegible] from [illegible] one of the [illegible] beds and they will be [illegible] this winter. The coal is much firmer than that of Kayanoma and will therefore bear rough handling and distant transportation better than that does. In the portion of the coal that we went over there would seem to be perhaps [illegible] millions of tons of coal above the natural drainage level. The hills are high (some five hundred feet) and the larger valleys are wide enough for mines to be opened near the points where the outcrops of the several [illegible] cross the streams. ¶ It is a dozen miles (five ri) to the nearest water navigable for large boats (the Ishcari River) and the country between seems to be wholly a flat plain, mostly covered with heavy (but rather open) timber, with here and there treeless prairies and sometimes swamps. From the nearest point of the Ishcari the distance by river to the sea is about miles [illegible] the water is said to have been found by Lieut. Day's survey this season to be deep enough for vessels drawing fourteen feet, except on the bar at the mouth where for a short space there are but

twelve feet at low tide. In another direction a railroad might be built over almost wholly level ground to the excellent harbor of Mororan about eighty miles (thirty two ri) distant. Unquestionably the amount of coal in the field would enable the shipment of coal enough to repay amply the cost of such a road.

The [illegible] at [illegible] [illegible] (three beds from two to fourteen tenths of a foot thick) were yet found by Mr Munroe to be interesting from the fact that [illegible] there had a strike of about north fifteen degrees east like the coal rocks of Hayanoma and the Horumui.

Iron Sand. — The only ore of iron that has yet been found in any quantity in Yesso is magnetic iron sand. It is most abundant on the south shore of Volcano Bay, especially near Tamukushinai. It is also found in some quantity near Kobui on the eastern end of the peninsula east of Hakodate. Though these two are the only workable places yet found the magnetic iron ore is also found in some quantity on many a beach

and in the sands of many a river bed. Indeed spa-
ces of it at least are found in almost every
deposit of sand even though not noticeable
to the naked eye before separation by a mag-
net. It is sprinkled through many of the wide
spread volcanic rocks of the island and from
the wearing away of these rocks, their reduction
to sand and concentration of the heavier ore
by the washing of the tides and waves or rivers that
the sand ore deposits are due.

The iron sand deposit on the shore from
Yurap to Otoshibe and perhaps a little beyond
at either end is say ten miles (four ri) or
17600 yards (8800 ken) long by twenty yards
(ten ken) wide on the average and perhaps half
a foot thick on the average; making in all
58667 cubic yards (7333 cubic ken). The ore
looks very rich in many parts but is generally
mixed with a notable amount of other sand.
If it would average eighty percent of pure
ore there would be about 120000 tons of it
which would contain 87000 tons of iron. The
ore seems to contain a certain amount of
titanium, for at the old forge near Oko-

its quantity of Kobin ore to make it more fusible. The old iron works of Okotomai
the ore was found paid to work alone, and was mixed with half of
kumai, half a mile from the sea shore and a
mile and a half (half a Ri) from [illegible]
were first built some ten years ago worked
a couple of years, were left a year and a half,
worked again four or five years and were
finally abandoned three years ago and are
now in ruins. There were two bloomary fogs
with large bellows worked by a water wheel.
The furnaces were worked only in the summer
half of the year; eight workmen were em-
ployed daily in two shifts, four in each; and
5800 lbs. (700 kamme) it is said were made
three days, that is 1933 lbs in one day (perhaps
in some exceptional case only). The amount of
charcoal burned was three and a half times
the weight of iron produced, they say, and
now one quarter of a cent a pound (twelve and
a half sen for six kamme); formerly it was
little cheaper. For the mere washing of the ore
there is plenty of water in the small streams
that cross the iron sand and empty into
the sea at every little distance. The same
streams would float down wood for charcoal
to be used in smelting, and the supply from

the Tarrap valley would be very large. Besides the iron sand reckoned with [illegible] you [illegible] there is a very large amount of poorer sand either in underlying layers or in neighboring places, and with cheap labor it is quite possible that more are could be washed.

At Kobui village on the sea shore, [illegible] seven miles (eleven ri) easterly from Hadodate is a deposit of easily smelled iron sand. At the thickest point it is about [illegible] thick but thins out to a knife edge in all directions from that. The whole length of the deposit is about six hundred yards, almost all (say five sixth) of it either very thin (one tenth of a foot) or comparatively poor. There are perhaps in all 250 cubic yards (thirty one cubic ken) of sand containing perhaps two hundred cubic yards or say four hundred tons of pure ore, which would hold 299 tons of iron.

About a mile (half a ri) southwesterly from Kobui village is some more rich sand at the mouth of the Otsuki river. Ore was taken here and at the village for the blast

[illegible] where [illegible] half a mile
[illegible] inland on the Mississippi; but [illegible]
and the ore was abandoned within the first year
[illegible] years ago. About ten years ago a single
boat load it is said of ten koku (perhaps one
ton and two thirds) of sand was sent from
the mouth of the Otsuki river to the iron work
near Yamukushinai to be mixed with the ore
there as already mentioned. No other working
of the sand has been done. The rich part
of the deposit is about thirty yards (fifteen
ken) in diameter with a thickness of two
feet and eight tenths at the centre; and
contains perhaps 700 cubic yards of sand
of which perhaps 500 yards or 1000 tons
be pure ore, containing 725 tons of iron. From
this place for four hundred yards or [illegible] towards
Kobui is poorer sand, formerly thought too
poor to work some [illegible] yards wide and
perhaps a foot thick on the average, making
in all 3667 cubic yards, containing perhaps
2000 cubic yards or 4000 tons of pure ore
holding 2900 tons of iron. That would make
in all at Otsuki 5000 tons of ore containing

3630 tons of iron. But these estimates of the richness of the sand at all the places are mere guesses from looking at it, as no assays have yet been made of the samples taken. No more solid bed of black ore is known in this region.

At Shirikishinai on the sea shore near Kobui and twenty five miles (ten ri) from Hakodate is a small bed of iron sand say a hundred yards long by twenty five yards wide and said to be one foot and three tenths thick at the thickest place, and containing therefore some 100 cubic yards. The sand does not look very rich and holds perhaps in all 140 tons of pure ore or 100 tons of iron. The sand was worked seven ten years ago and during three years after that for a furnace on the Monobonai river near by at two miles (thirty ri) from the mouth. The furnace is said to have been oblong square in form, seven feet long by four wide and four feet high and built of clay; and to have been of the kind used in Nambu, the neighboring province of Rikuzen. The iron they say was soft and

pretty good, though not the best, and its working was abandoned from the smallness of the quantity of ore.

No vein of solid ore has yet been found anywhere and most likely there is none. In one case however, in a gully on the side of the volcano Komangadake a layer of magnetic iron sand a foot thick was found regularly bedded with the other volcanic rocks and about seven feet and a half from the surface of the hill. It is 1150 feet above the sea and two miles and a half (one ri) distant from it. It seems to be exposed nowhere else and its extent and persistence in thickness is quite unknown. Above it is only loose pumiceous which would need to be stripped off in case the ore were worked. Perhaps it may at some future time be thought worth working and can then be explored by digging but at present it does not seem worth while.

The whole amount of pure ore in the principal workable deposits is perhaps 12500 tons containing 9000 tons of iron. Only 5300 tons of the ore (containing 4000 tons of iron) are of the easily smelted kind.

pretty good, though not the best; and the working was abandoned from the smallness of the quantity of ore.

No vein of solid ore has yet been found anywhere, and most likely here is none. In one case however, in a gully on the side of the volcano Kornangadake a layer of magnetic iron sand a foot thick was found regularly bedded with the other volcanic rocks and about seven feet and a half from the surface of the hill. It is 1150 feet above the sea and 1150 miles and a half (one ri) distant from it. It seems to be exposed nowhere else and its extent and persistence in thickness is quite unknown. Above it is only loose pumice which would need to be stripped off in case the ore were worked. Perhaps it may at some future time be thought worth working and can then be explored by digging but at present it does not seem worth while.

The whole amount then of pure ore in the principal workable deposits is perhaps 125500 tons containing 91000 tons of iron. Only 5500 tons of the ore (containing 4000 tons of iron) are of the easily smelted kind.

Sulphur. — The sulphur occurs mostly within the craters of now inactive volcanoes. Hot sulphur fumes rise through small crevices and deposit yellow sulphur on the cold surface of the ground forming a crust or less impure with a mixture of partially decomposed rocks. The shape of such deposits is extremely irregular and often rather inaccessible in many parts; so that the precise extent can hardly be measured except very roughly. At the place at Esan (the only mine worked at present) some four tenths of the surface over which the deposit is scattered seemed to be covered with sulphur earth. The thickness of the sulphur large there is about half a foot but the lower part is so very impure that only one twentieth to one fifth of a foot, perhaps one tenth on the average, is at present thought worth gathering. This gathered impure mixture yields it is said four tenths of its weight of sulphur. If this be taken as a guide in estimating the quantity at the different places there would be at Esan (guessing roughly) two koku or about sixty three tons of sulphur to

Sulphur. — The sulphur occurs mostly
within the scales of [illegible] volcanoes
[illegible] sulphur [illegible] [illegible] small [illegible]
[illegible] and deposits yellow sulphur on [illegible]
surface of the ground forming a crust [illegible]
or less impure with a mixture of partially
decomposed rocks. The shape of such deposits
is extremely irregular and often rather inaccessible
in many parts; so that the precise extent
can hardly be measured except very
roughly. At the place at Esau (the only mine
worked at present) some four tents [illegible]
[illegible] over which the deposit is scattered [illegible]
[illegible] covered with sulphur earth. The thickness
of the sulphur layer [illegible] is about half [illegible]
[illegible] the lower part is [illegible]
[illegible] to one [illegible] of a foot, [illegible]
[illegible] tenth on the average, is at present [illegible]
[illegible] gathering. This gathered impure [illegible]
[illegible] yields it is said four tenths of [illegible]
[illegible] sulphur. If this be taken as a [illegible]
[illegible] the quantity at the [illegible]
[illegible] there would be at Esau (guessing roughly)
[illegible] or about [illegible] [illegible] sulphur [illegible]

be won, but the workmen there estimate the amount at less than one fourth of that, owing perhaps in part to its having been worked out in places since the working has been going on for a dozen years on a small scale. There may perhaps be thirty tons (or nearly 200 koku) left.

The Esan sulphur is on the northern side of the crater of a volcano long inactive and on the close adjoining slope of the mountain just outside the crater. The elevation above the sea is from 1250 to 1550 feet) and by road the distance is about a mile and a half a long half ri). In the middle of the plain half a mile in diameter that now fills the old crater, stand the small sulphur works, where for a dozen years (in the summer months) the sulphur earth has been purified by melting. It is melted three times over in three large pots two feet in diameter and three in depth. The stones and dirt mostly sink to the bottom of the pots and are separated so; but the sulphur after the last melting is strained through thick canvas. Five men do the whole work of gathering the sulphur, bringing it to the furnaces, tending

the melting and packing the sulphur in bags to be carried to the sea shore at Netanai. One hundred koku or about sixteen tons of sulphur are made in three months at the following cost according to the workmen.

	En	En
Wages of five men at $10		50,00
Food for five men for three months		
Rice	16,87½	
Miso	9,00	
Soy	5,62½	
Salt	0,56¼	
Pickles	4,50	
In all	36,56¼	36,56¼
Iron pots		189,00
Wood fuel 75 cords of 1,05 ft. a 1,06¼ ¢		76,93¾
Cotton bags		53,12½
Picks, hoes, hammers, skimmers and other tools		33,87½
Kegs for moulds		18,75
Mats and ropes for carrying sulphur earth		10,87½
Mats and ropes for carrying sulphur to [illegible]		28,75
Horse hire for carrying sulphur		15,37½
		513,25
Carriage of sulphur to Hakodate		25,00
		538,25

	£	s.	d.
Wages of Foreman ...	3	0	0
Wages of Fitter ...	2	10	0
Wages of Turner ...	2	0	0
Wages of Smith ...	2	0	0
Wages of Fireman ...	1	10	0
Wages of Labourer ...	1	0	0
Wages of Labourer ...	1	0	0
Wages of Labourer ...	1	0

At the price of sulphur at Hakodate is said to be from three hundred to three hundred and fifty dollars (Sn) for 100 koku it is possible that there is some mistake in the statement just given, but it is also possible that the sulphur is manufactured at a decided loss. Since the wood costs at Actanai only eighty seven and a half cents (sen) for one cord, the saving in respect to it, if the furnaces were on the shore would just about equal the additional expense of bringing down there the impurities of the sulphur earth, and there would besides be many advantages in having the furnaces there. Horses could go all the way from the sea to the mines. The great expense for kettles would be reduced one half by working at night also, instead of merely keeping the sulphur liquid in the kettles as at present. Although sulphur is so valuable and rare a mineral, no royalty is taken for it; in order, it is said, to encourage its manufacture.

The sulphur on the top of Tarumai Volcano about nine miles (3¾ ri) from Tarumai village on the sea shore is wholly within the inner crater of about 400 yards in diameter

[illegible]

and 250 feet below the edge of the outer crater lip [illegible] is about 3000 feet above the sea. The sulphur appears to be in the deposit only, one of them in crescent shape about four hundred yards long by twenty yards wide the other about thirty yards long by twenty yards wide; making in all them a surface of 8600 square yards. Reckoning the same average thickness of workable sulphur earth as at Esan, there would be about thirty five tons (or over 200 koku) of sulphur to be won here. The very abundant fumes here as at Esan must be constantly adding to the deposit, but how rapidly there is at present no means of judging. The present deposits however have probably accumulated since the last eruption, a small one about seven years ago. The sulphur was formerly worked for three years, but abandoned thirteen years ago. The ruins of the furnaces with places for at least five pots are still to be seen about two miles (twenty seven chs) below the mines. Horses could go all the way to the mines from the sea.

The sulphur on the top of Iwaonobori is about fourteen miles (5½ ri) from the sea at at Iwanai, and about 3500 to 3800 feet above the sea.

The sulphur deposits cover [illegible] seventy thousand square yards and would contain by the same reckoning as at Esan perhaps seventy five tons (or 150 koku) of sulphur to be won. The ruins of the old sulphur works abandoned five years ago after many years of work are just below the mines and seem to have been larger than those at Tarumai. The road to them from Iwanai is passable for horses and even beyond that as far as the mines; but the last two or three ri are at present very bad, though a good road for horses could be built without very great difficulty. If the Shiribets valley as it deserves should be opened up by a wagon road from Isoya, the distance to the road from the sulphur mines would be perhaps only a couple of miles (or a ri). The sulphur fumes are ~~very~~ less abundant here than at Esan and Tarumai.

The Naburibets sulphur is found in a small valley close by the Naburibets hot springs about nine hundred feet above the sea and at ~~[illegible]~~ about four miles from the sea & have at a point seventeen miles (seven ri) from Mororan by the Nebo road. The sulphur place here hardly seems to be an old crater,

Though possibly it may be [illegible] found however this [illegible] and other appearances [illegible] [illegible] [illegible]

a few miles (2 or 3 and a half or two M.) from the
Inn village near the mouth of that river on the
sea shore; and partly at a place known
this year as a branch of the same stream
called a marsh. Both marsh and [illegible]
of a settled [illegible] [illegible]
would make the [illegible] of all the
[illegible] places. The [illegible] [illegible]
[illegible] [illegible]
one foot thick
[illegible]
[illegible]
[illegible]

be sold [illegible] of [illegible] [illegible] [illegible] [illegible] probably in a [illegible] or [illegible] [illegible] [illegible] is not likely to be very uniform in thickness nor very widespread. The same may be said of the newly discovered gray sulphur a mile to the northwest, which however is exposed for a space of a hundred feet in length in the bank of a small ravine and [illegible] four yards in height partly very pure, partly [illegible] with earthy impurities. Perhaps one third of the whole is pure sulphur. It might perhaps be well enough to count upon the hundred tons of sulphur herein all, and twenty five tons at the old mines, but the quantity may prove to be far greater.

The whole quantity of sulphur to [illegible] got from the places visited this year would seem [illegible] to be possibly five hundred tons (three thousand koku). The completion of our maps may bring about very important changes in these estimates.

Limestone — The principal exposure of limestone is on the small stream Gorumo-sawa, about five miles from Arikawa

and [illegible] which are seven miles [illegible] [illegible] the bay from Hardodale. The limestone is exposed in cliffs on the hills either side of the brook to a height of perhaps six hundred feet for a distance of some four miles. The amount then within one yard of the surface would be (very roughly) some eight million cubic yards or twenty million tons. As the whole depth is probably many yards, perhaps hundreds of yards that quantity is very little compared with what may be expected to exist within the hills and may be safely considered as inexhaustible for a thousand years. Of that amount perhaps twelve thousand cubic yards or thirty thousand tons are already in loose blocks in the bed of the brook. The quality seems to be very good indeed, says one half. dark blue limestone, the other half light grey. It all seems very much metamorphosed, in some small parts even like marble; and no fossils could be found. The cleavage planes are very strongly marked and often [illegible] the dip; but at least one saddle in the rock (anticlinal) is to be clearly seen

with a course of north five degrees east magnetic sinking five degrees in the opposite direction, south five degrees west, the bearing of the thermomic graph system of axes. A wagon road or a railroad could easily be built with down grade all the way about four miles to the sea shore. Wood at the limestone costs two dollars a japanese cord (125 feet).

On the sea shore at the western end of the village of Ishizaki ten miles (four ri) east of Hakodate begins an exposure of gray and tile pure looking lime rock about 250 yards long in cliffs on the side of a bluff eighty five feet high. The whole amount in sight may perhaps be 2000 cubic yard or 5000 tons. No doubt a far larger amount exists behind what is in sight; namely 15000 cubic yards or 40.000 tons for every six feet (one ken) back from the face of the bluff or in 100 yards, 75000 cubic yards or 2.250.000 tons.

The Kamio Yuno-Sawa limestone about five miles (two ri) northeast of Hakodate is exposed on both sides of a very small valley here and there for a space of a quarter of a mile. Thus 800 cubic yards or 2000 tons (very roughly speaking)

seem to be exposed. The quality is good; and a kiln is in use here since last year for burning the stone to make lime. The kiln is thirteen feet high by six feet in diameter, cylindrical; and (it is said) burns 1750 lbs. (210 kammes) of lime at a time during three days, and burns twice and a half in the month or 4325 lbs. (525 kammes) about two tons in all. Nine Japanese cords (of 125 feet) of wood, at $1.15 a [illegible] are burned each time, that is $1.60 for a [illegible]. The earnings of one horse had at 20½ lbs. of lime to Hakodate is $0.15 or $1.50 a [illegible]. Borrowers wages are $0.25 a day. The lime at Hakodate brings $7.50 a ton (or 5½ [illegible] as his of fourth or 13100 ame). A wagon road to Hakodate could be made with very great ease, as it would be almost wholly over nearly level ground free from rocks and trees.

About a mile ([illegible]) from Wakinoki on the sea above some gray lime stone is exposed that is rather impure with clay, but on burning may make strong lime. The exposure is at the axis of a basin (synclinal) with a dip of sixty degrees on one side and one of eight five degrees [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible]

[illegible]

To Pothuber's Kraft system of portfolios. 28

thickness of the limestone is about four yards in all beds some resembling many clay-shales perhaps may also [illegible] only a quarter of a mile (½ km) inland and have an average height of [illegible] above the level of the surface of the ground. The whole amount would be [illegible] cubic yards [illegible] [illegible] [illegible]

Gold.— The Cabul gold field surveyed [illegible] in the form of [illegible] and scales of [illegible] The [illegible] rocks are of the Vindhyan Series consisting chiefly of soft sand stone and clay stone. No gold bearing quartz vein has yet been discovered, but the grains of gold occur in the ravines and nullahs which run into the gold bearing [illegible] The gold bearing [illegible] [illegible] are known to extend [illegible] along the river from [illegible] and [illegible] and to [illegible] [illegible] [illegible]

of gold to a million dollars or even less. Of course the cost of washing the gold should be subtracted from that in estimating its value. The streams seem to furnish ample amounts of water at a cost of [illegible] for washing the whole by the hydraulic method, without very long flumes. It is hardly probable however that as poor and small a creek would pay for working on a large scale. Washing by hand as little as pan-bred yields about twenty cents a day to each labour, rather scanty wages for [illegible]. The [illegible] was not pushed to the very uppermost (or the uppermost) limit of the field, and it is possible that a small extent of somewhat richer ground may be found there, since the grains are slightly larger in that direction. But that part of the valley is narrow and must be [illegible] [illegible] [illegible] [illegible] [illegible] [illegible].

Near Kuhow Mr. Munroe found about a third of a square mile of gold bearing [illegible] four & eight feet thick, power [illegible] [illegible] of the [illegible] bets, [illegible] as "marlite, volcanic and metamorphic rocks." The whole value of the gold within the field would be then only some eighty thousand dollars, and probably quite too much scattered to work at all.

[illegible] found on the [illegible]
[illegible] about one mile [illegible] gold
bearing [illegible] [illegible] [illegible]
[illegible] [illegible] [illegible] [illegible]
[illegible] [illegible] [illegible] [illegible]
[illegible]

[illegible] would [illegible] [illegible]
millions and [illegible] of dollars, and [illegible]
[illegible] [illegible] [illegible] [illegible] [illegible]
encouragement [illegible]

Rock Bar. — [illegible] [illegible] [illegible] [illegible]
[illegible] [illegible] [illegible] [illegible] [illegible]
black and as very little [illegible] [illegible] [illegible] the
name of Dr. [illegible] [illegible] [illegible] [illegible]
[illegible] [illegible] [illegible] [illegible] [illegible]
rock pit in the [illegible] [illegible] [illegible]
[illegible] [illegible] [illegible] [illegible] [illegible]
[illegible] [illegible] [illegible] [illegible] [illegible]
of the Washington [illegible] [illegible] [illegible] [illegible]
similar [illegible] [illegible] [illegible] [illegible]
alluvial gravel [illegible] [illegible] [illegible]
[illegible] [illegible] [illegible] [illegible] [illegible]
[illegible] [illegible] [illegible] [illegible] [illegible]
alluvial gravel [illegible] [illegible] [illegible]
[illegible] rocks below [illegible] [illegible] [illegible]
[illegible]. [illegible] [illegible] [illegible] [illegible]
[illegible] [illegible] [illegible] [illegible] [illegible]
[illegible] [illegible] [illegible] [illegible] [illegible]
[illegible] [illegible] [illegible] [illegible] [illegible]
[illegible] [illegible] [illegible] [illegible] [illegible]

The [illegible] [illegible] [illegible] [illegible] [illegible]

[illegible] [illegible] [illegible] [illegible] [illegible] [illegible]
planes, so that its [illegible] [illegible] the [illegible]
[illegible] and [illegible]. [illegible] the oil springs are [illegible]
within a narrow space and would [illegible] [illegible]
fore [illegible] but a small portion of the
oil bearing beds of rock. It is not likely [illegible]
that a large yield [illegible] [illegible] can ever be got away;
and as with so steep a dip the depth and con-
sequent cost of wells would very rapidly in-
crease according to the distance from the out
crop at which they are bored; the encouragement
to such undertakings in view of the small yields
of the present wells is not very great.

The oil at Yamukushinai is found wholly
within the village in the alluvial gravel of a
plain 150 yards (75 ken) wide that borders the
sea shore. The main well dug last year
is a hole some ten feet square and eight
feet deep loosely walled at the sides with
wood. About twenty four gallons were taken
here as the accumulation of the past year
and in the next day a little over three pints
(about one sho) collected there, which was so
thick as to have the specific gravity of eleven de

grees of Beaumes scale. Another well somewhat smaller dug by a merchant at about seventy (thirty five ken) yards of the main well yields only a few drops of oil in the day. One or two other very small holes one foot or so in diameter have exposed the same black thick oil in the gravel. But all these exposures are within a diameter of about a hundred yards (fifty ken) except a slight trace at a distance of four hundred yards (200 ken) south of the main well. The deposit then appears to be of very limited extent; for, although the underlying rock from which the oil probably comes have a dip of twenty five degrees or so and an outcrop running doubtless a long distance through the country, there is nowhere else a trace of oil coming from it. There is nothing then to encourage very expensive exploration by boring perhaps it may be worth while to gather what oil can be got by digging small inexpensive wells near the main one, and if they turn out profitable it may sometime be good to sink a small bore hole to a short depth near the main well. The thickness of the oil goes to show that it is a very superficial deposit. Besides the

65

sic here then are perhaps forty cubic feet of asphalt (dried oil) which would weigh [illegible] [illegible] and a half.

The oil at Idzumisawa is in a [illegible] ravine about a mile from the village and about the same distance from Kamaya and about half a mile from the sea shore. It is only found at the main well and in mere traces at some other holes within ten yards of that. The main well dug last year is a hole about four yards long by a yard and a half wide and two yards and a half deep with about four feet of water in the above [illegible] ten gallons (two koku and one t) were taken here as the accumulation of the past year; and the three days afterwards an average of [illegible] quarts and [illegible] gills and three quarters (one sho and a half) were taken which marked eleven degrees Beaumé, it was so remarkably thick. The oil comes almost wholly from one corner, from greenish gray somewhat shaly broken sandrock with a dip of some twenty degrees. Although much digging has been done close about here only traces of oil have been found and not even so much as

[illegible] of any [illegible] part of the necessarily extended outcrop of so [illegible] [illegible] therefore highly unwise to undertake the boring of wells along the outcrop, especially very deep ones.

Mineral springs. [illegible] springs are quite numerous and of varied character in the southern part of Texas. They have all been visited in passing with but two or three [illegible] exceptions, and the main facts in regard to them have been gathered so far as possible without a chemical analysis, and are given in the following table:

Name	No.	Heat Fahrenheit	Character.	Rock.	Place.	Remarks.
Oi Lake	1	77°	Sulphur with gas.	Blackmud	½ mile N.W. of Nuburibeh hot springs.	¼ mile wide [illegible] to sea.
Nuburibeh	5	99°	Sulphur with gas.	Alluvial earth	[illegible] Nuburibeh Sulphur place and close by.	6 or more bubbling springs into sulphur [illegible] [illegible] [illegible] [illegible] [illegible] [illegible]
	7	83°				
	8	81°				
	9	[illegible]				
	10	48°				

Name	No.	Heat	Character	Rock	Place	Remarks
Jōgan	1	87°	A little	Granite	At Jōgan	No. 12 & 3
	2	87°	sulphureted	volcanic	Kōyahira	[illegible]
	3	87°	hydrogen		17 miles [illegible]	[illegible] 2 or 3
	4	85°			[illegible]	[illegible]
	5	85°			within 100 yds.	[illegible]
	6	88°				
Obune.	1	78°	Sulphur	Alluvial	1 ri inland	[illegible]
	2	74°	rotted	gravel	from [illegible]	[illegible]
	3	75°	hydrogen		domari &	[illegible]
	4	68°			Usudzui	[illegible]
Isoya.	1	72°	Sulphur	Gray	½ ri inland	All within
	2	69°	rotted	Soft	from Isoya	200 yds. and
	3	67°	hydrogen	Clay.	between [illegible]	not large.
	4	67°	[illegible]		kabe & [illegible]	
	5	46°			[illegible]	
Nigorikawa	1	57°	Sulphureted	Alluvium	1½ ri from sea	[illegible]
	2	55°	[illegible] Hydrogen		Shore near	[illegible] 50 yds.
	3	57°	without gas		[illegible]	[illegible]
	4	49°	bubbles except		[illegible]	sea [illegible]
			No. 4.		[illegible]	[illegible]
Esan	1	53½	Hyacid	Alluvium	On [illegible]	[illegible]
	2	50½	and astringent		[illegible] from [illegible]	[illegible]
	3	45?	Sulph. Hydrogen		[illegible]	[illegible]

					Place	Remarks

Name	No.	Temp.	Character	Rock	Place	Remarks
Swrap	1	40°	Iron,	Alluvium	[illegible]	[illegible]
	2	35°	Magnesia		[illegible]	[illegible]
Yunskawa	1	35	Iron carbonate with gas	Alluvium	At Yunskawa village [illegible] N.E. of Hakodate	Small.
Bore.	1	33	Iron carbonate	Alluvium	1 [illegible] from [illegible]	Small
	2	27	with gas.		[illegible]	
Yunosaki	1	[illegible]	Many coppers with gas	Alluvium	4 cho W. of [illegible] [illegible] near sea	Small, on sand close by cold spring
Tomi	1	50½	nearly pure water	Alluvium	1½ [illegible] from [illegible] 2 [illegible] from [illegible]	Small
Kamiyunosawa	1	35	nearly pure water	Alluvium gravel	At Yunosawa [illegible] 2 [illegible] N.E. of Hakodate	pretty large
Sudomari	1	33°	Sulphur	Pale greenish	At Sudomari	Water used
	2	32½°	and	Volcanic	[illegible] "copper [illegible]"	[illegible]
	3	29°	Coppers	porphyry	near Sakkaro	
	4	27½°	with gas		[illegible]	

Of these twenty one springs, then, there are thirteen sulphur springs with temperature from coldness up to boiling, six iron springs from 27° to 91°; one cold spring with coppers and two nearly pure springs 33° and 27½°.

Hoping that this statement of the probable results of the season's survey may be of some use to you, I shall wait until they can be worked out more exactly; I have the honor to remain,

Sir,

Your most Obedient Servant

Benj. Smith Lyman,

Chief Geologist & Mining Engineer.

[illegible]